

Add Support of Transient Analysis in SPIM, with [SPIM icct File]

SPIM = Streamlined Power Integrity Model

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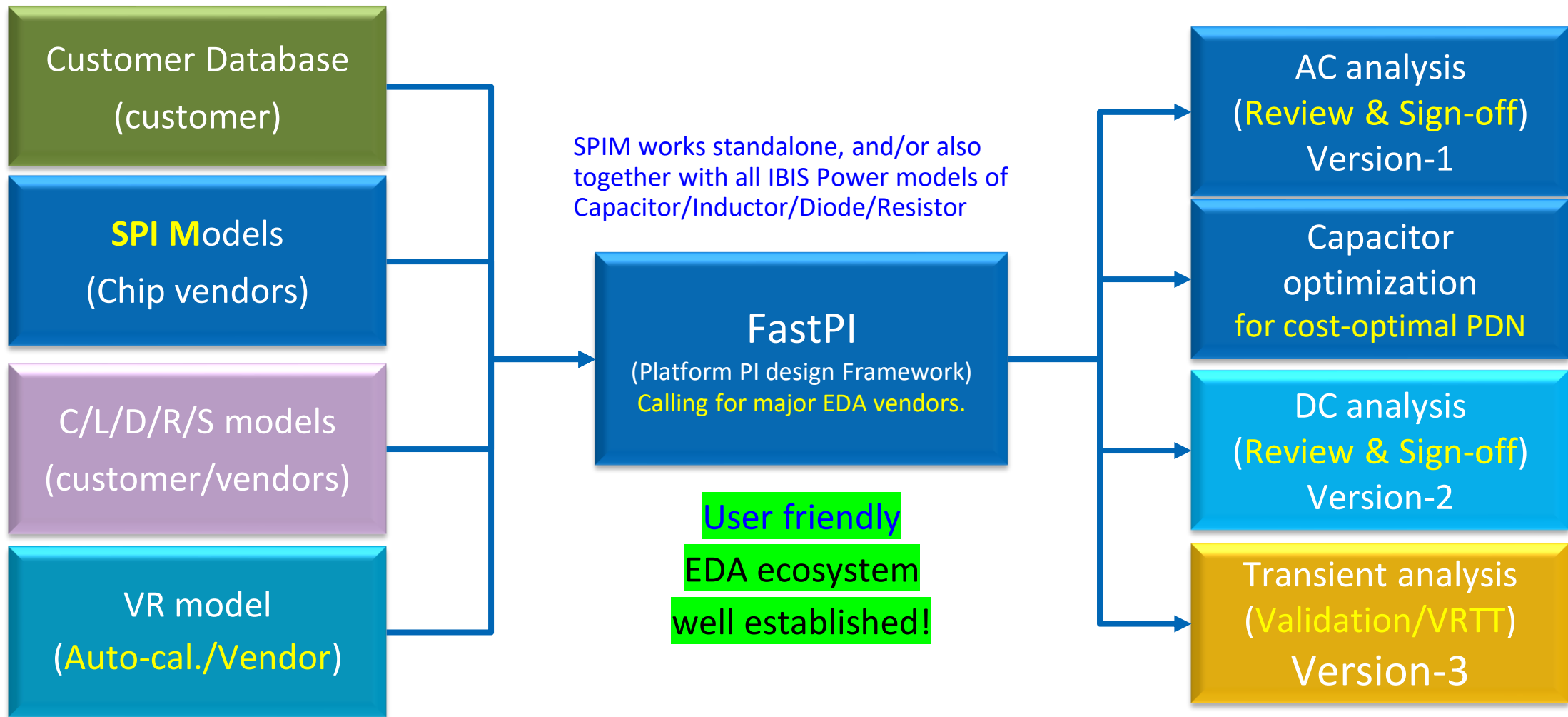


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SPIM Status Quo & Expansion

- Supports in BIRD223.1, approved in Dec. 2023
 - AC impedance, with [SPIM Touchstone File] and [SPIM Target]
 - DC analysis, with [SPIM Rnetwork File] [SPIM Current] and [SPIM Voltage List]
- Add Support for Transient analysis
 - Add [SPIM icct File], and its generation & application
 - Add [SPIM Transient Target] for Peak-to-Peak noise V_{pp} , V_{min} and V_{max}

FastPI (Platform PI Arch. with SPIM) Roadmap



IEEE Paper: [Scalable Platform Power Integrity Design Approach with Standard PI Model \(SPIM\) and Unified PI Target \(UPIT\)](#)

Tree Structure of .spim FILE (Defined in BIRD223.1)

```

.spim FILE
-----
|-- File Header Section
|   -----
|   |-- [IBIS Ver]
|   |-- [Comment Char]
|   |-- [File Name]
|   |-- [File Rev]
|   |-- [Date]
|   |-- [Source]
|   |-- [Notes]
|   |-- [Disclaimer]
|   |-- [Copyright]
|
|-- [Device SPIM]
|   -----
|   |-- [Manufacturer]
|   |-- [Description]
|   |
|   |-- [SPIM Rail]
|       -----
|       |-- [SPIM Pin Cluster]
|           -----
|           |-- [End SPIM Pin Cluster]
|           |
|           |-- [SPIM Port List]
|               -----
|               |-- [End SPIM Port List]
|
|   |-- [SPIM Touchstone File]
|       -----
|       |-- [SPIM Stimulus]
|           -----
|           |-- [End SPIM Stimulus]
|       |-- [SPIM Target]
|           -----
|           |-- [SPIM Observation Port]
|           |-- [End SPIM Target]
|       |-- [End SPIM Touchstone File]
|
|   |-- [SPIM Rnetwork File]
|       -----
|       |-- [SPIM Current]
|           -----
|           |-- [End SPIM Current]
|       |-- [SPIM Voltage List]
|           -----
|           |-- [End SPIM Voltage List]
|       |-- [End SPIM Rnetwork File]
|
|   |-- [End Device SPIM]
|
|-- [End]

```



Insert new keywords.

.spim FILE Tree Structure Implication & Example

```
|
|
|  |-- [SPIM Rnetwork File]
|  |-----
|  |  |-- [SPIM Current]
|  |  |-----
|  |  |  |-- [End SPIM Current]
|  |  |-- [SPIM Voltage List]
|  |  |-----
|  |  |  |-- [End SPIM Voltage List]
|  |  |-- [End SPIM Rnetwork File]
|
|  |-- [SPIM icct File]
|  |-----
|  |  |-- [SPIM Transient Target]
|  |  |-----
|  |  |  |-- [SPIM Observation Port]
|  |  |  |-- [End SPIM Transient Target]
|  |  |-- [End SPIM icct File]
|
|  |-- [End SPIM Rail]
|
|  |-- [End Device SPIM]
|
|-- [End]
```

```
*****
|Information for Transient analysis
|*****
|
|[SPIM icct File]
|  Text file in two columns of time and current amplitude
|  File_name           Time_Delay   Repeat_time
Intel_CPU_VCC1_icct.txt 0.0           0.0
|
|[SPIM Transient Target]
|[SPIM Observation Port] OB_Sense
| Vpp      Vmin      Vmax
| NA       0.600    1.400
|
|[End SPIM Transient Target]
|[End SPIM icct File]
|
|[End SPIM Rail]
|
|*****
|
|[End Device SPIM]
|
|[End]
```

Example .spim FILE -Supports Transient Analysis

```

|
|*****
|Information for Transient analysis
|*****
|
|[SPIM icct File]
| File_name           Time_Delay   Repeat_time
Intel_CPU_VCC1_icct.txt 0.0         0.0
|
|[SPIM Transient Target]
|[SPIM Observation Port] OB_Sense
| Vpp      Vmin      Vmax
| NA       0.600    1.400
|
|[End SPIM Transient Target]
|
|[End SPIM icct File]

```

Intel_CPU_VCC1_icct.txt

*time (second)	Current(A)
0.00000E+00	2
100.000E-09	2
105.000E-09	10
1500.00E-09	10
1505.00E-09	2
3000.00E-09	2
... ..	

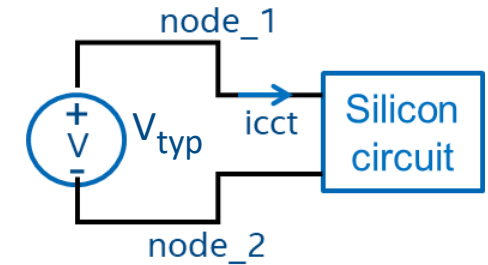
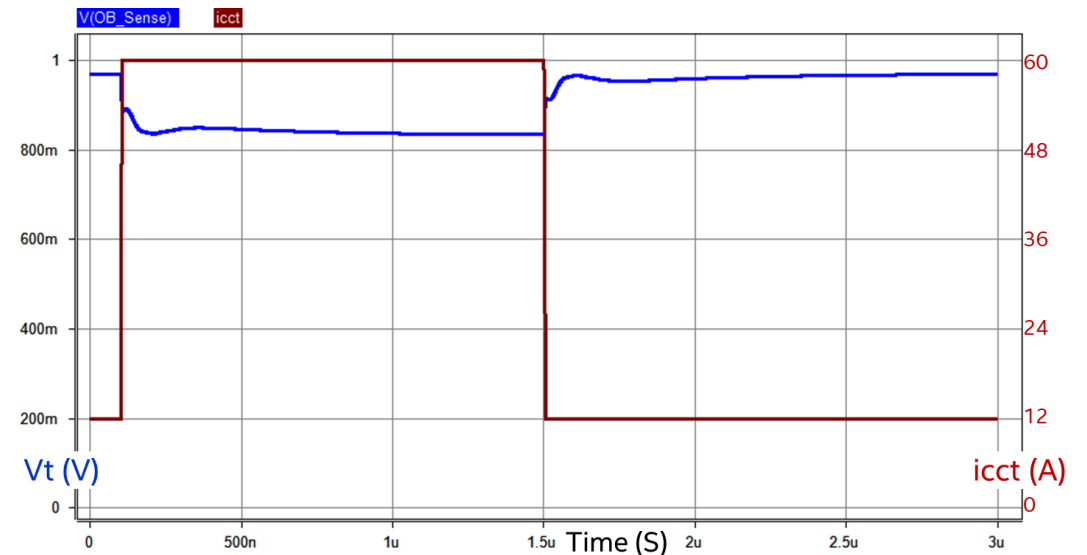


Fig.1 icct generation



SPIM Transient Analysis Setup

Intel_CPU_VCC1_icct.txt

*time (second)	Current(A)
0.00000E+00	2
100.000E-09	2
105.000E-09	10
1500.00E-09	10
1505.00E-09	2
3000.00E-09	2
...	
...	

```
[SPIM Stimulus]
|OB_Stimulus Weighting
OB_Stimulus_1 0.20
OB_Stimulus_2 0.10
OB_Stimulus_3 0.05
OB_Stimulus_4 0.05
OB_Stimulus_5 0.20
OB_Stimulus_6 0.05
OB_Stimulus_7 0.05
OB_Stimulus_8 0.30
[End SPIM Stimulus]
```

- icct profile under typical voltage directly at circuit node is shown in Fig.1.
 - icct might specify time delay or repeat time, with default values of 0.
 - In Power Integrity transient simulation with an actual power delivery network (PDN), the icct profile shall be connected as shown by Fig.3 through G element with the 2nd Polynomial function for accuracy, other than the 1st order connection as shown in Fig. 2 for efficient analysis.
- * For example,
- *.SUBCKT VCC1_icct node1 node2 V_{typ}='1.0'
- *Gpoly node1 node2 POLY(2) node1 node2 p n 0 0 0 0 '1/V_{typ}'
- ***VCCS i12 = 0+0*V₁₂+0*V_{pn}+0*V₁₂*V₁₂+'1/V_{typ}'*V₁₂

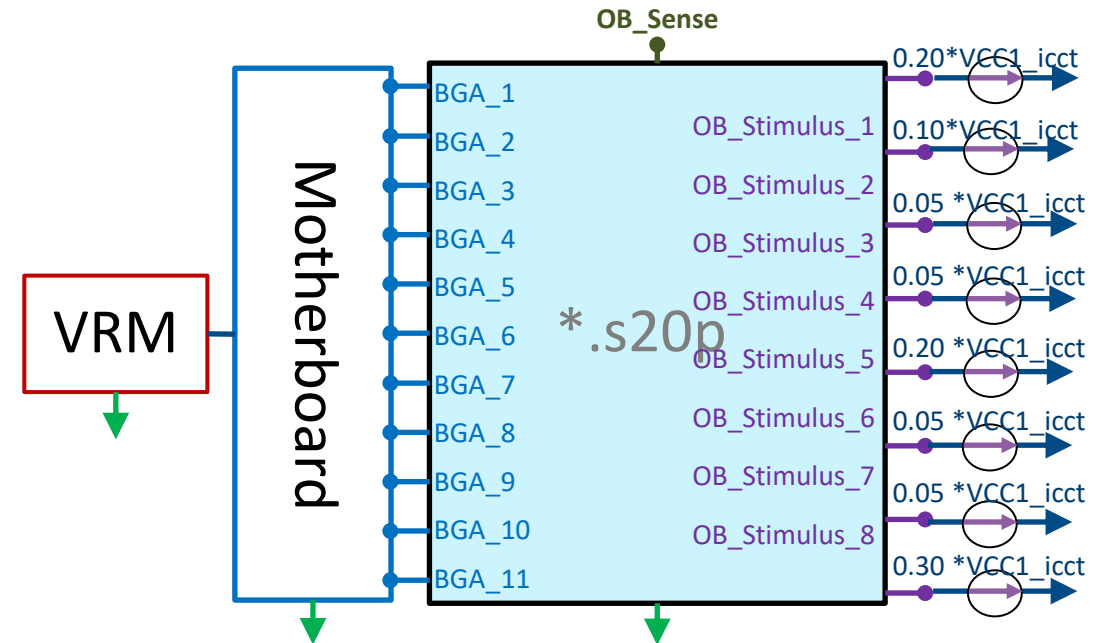


Illustration with the 1st order setup

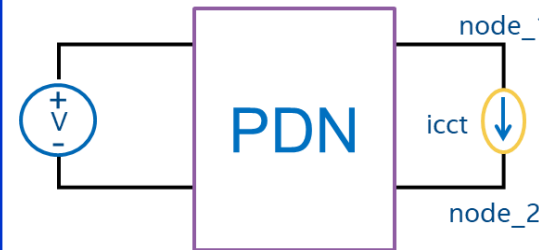


Fig.2 1st order setup

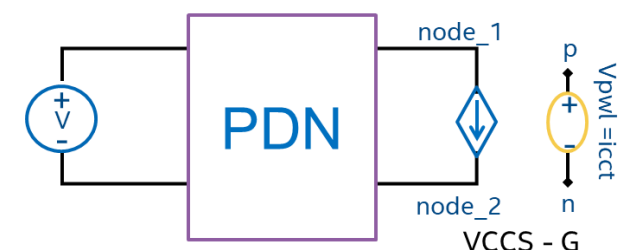


Fig.3 2nd order setup

Next Steps

- Submit IBIS BIRD of “Add Support of Transient Analysis in SPIM”
- Call for EDA vendors to support Transient Analysis in SPIM
- Call for chip vendors to support Transient Analysis in SPIM
- Call for platform designers to support Transient Analysis in SPIM

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Kinger leads AI PC coherent architecture strategy in mobile platforms and drives strategic platform EDA tools & algorithms evolution in Intel. Kinger obtained Ph. D from Shanghai Jiao Tong University in 2001, and achieved MBA degree from W.P. Carey business school in ASU in 2008. Kinger has focused on signal & power integrity domains for 20+ years. Kinger holds 14 granted patents, and published 30+ papers.

THANK YOU!



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